

# **Exhibit 1**



Contents lists available at ScienceDirect

## Drug and Alcohol Dependence

journal homepage: [www.elsevier.com/locate/drugalcdep](http://www.elsevier.com/locate/drugalcdep)Injury, pain, and prescription opioid use among former National Football League (NFL) players<sup>☆</sup>Linda B. Cottler<sup>a,\*</sup>, Arbi Ben Abdallah<sup>a</sup>, Simone M. Cummings<sup>a</sup>, John Barr<sup>b</sup>, Rayna Banks<sup>b</sup>, Ronnie Forchheimer<sup>b</sup><sup>a</sup> Department of Psychiatry, Washington University School of Medicine, 40 North Kingshighway, Suite 4, St. Louis, MO 63108, USA<sup>b</sup> ESPN Enterprise Unit, ESPN Productions, Inc., ESPN Plaza, Bristol, CT 06010, USA

## ARTICLE INFO

## Article history:

Received 24 November 2010

Received in revised form

24 December 2010

Accepted 27 December 2010

Available online 28 January 2011

## Keywords:

Opioid use

Opioid misuse

Prescription pain pills

NFL players

Concussions

## ABSTRACT

**Background:** Athletes with injury-related pain, especially National Football League (NFL) players, are at increased risk for opioid use and misuse which may result in medical, psychiatric and social problems. This is the first study to evaluate the intersection of sports pain and opioid use and misuse among former NFL players.

**Methods:** A telephone survey of 644 retired NFL players from the 2009 Retired Players Association Directory was conducted (53.4% completion rate) from March to August 2010.

**Results:** Over half (52%) used opioids during their NFL career with 71% reporting misuse. Additionally, 15% of NFL misusers currently misused vs. 5% among players who used just as prescribed during their NFL career. Prevalence of current opioid use was 7%—3 times the rate of the general population. Multivariate analyses indicated that significant NFL pain increased the adjusted odds (AOR) of any current opioid use vs. non-use (AOR 6.76, 95%CI 2.88–15.87), as did moderate to severe mental impairment (AOR 1.88, 95%CI 1.19–2.98) and heavy drinking in the past week (AOR 2.15, 95%CI 1.17–3.98). Undiagnosed concussions singly predicted current misuse vs. use just as prescribed (AOR 4.25, 95%CI 1.12–16.22). Three variables predicted current misuse vs. non-use: significant pain (AOR 8.33, 95%CI 1.98–35.04), undiagnosed concussions (AOR 3.51, 95%CI 1.98–35.04) and heavy drinking (AOR 3.48, 95%CI 1.63–7.41). **Conclusions:** Players who misused during their NFL career were most likely to misuse currently compared to others. Current misuse was associated with more NFL pain, undiagnosed concussions and heavy drinking. Longitudinal studies are needed to determine the long term effects of opioid misuse among athletes.

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## 1. Introduction

Misuse of prescription opioids is increasingly recognized as one of the nation's most significant public health problems because it can lead to physical and mental impairment and even death (NIDA Research Reports, 2005; Simoni-Wastila and Strickler, 2004; Zacny et al., 2003; Denisco et al., 2008; Compton and Volkow, 2006; Substance Abuse and Mental Health Services Administration, 2009; Okie, 2010). Though there is no standard definition of misuse, common definitions range from "taking a medication in a manner other than prescribed or for a different condition than that for which it was prescribed," to "intentional self-administration for non-medical purposes, such as getting high" (Compton and Volkow,

2006; Denisco et al., 2008). Data from the U.S. National Survey on Drug Use and Health (NSDUH) indicate that 12.7% of the general population aged 26 and older report lifetime misuse of prescription pain relievers and that 1.6% report past 30 day misuse, with higher rates among some subgroups (Substance Abuse and Mental Health Services Administration, 2009).

Professional athletes around the world are the elite of their sport; this requires them to take chances on the court, field, and other sports venues. This behavior results in injuries, pain and subsequent prescription opioid use and misuse. While this paper addresses National Football League (NFL) players, all athletes—especially elite players—are at risk for these occupational hazards. Although many professional athletes experience pain as a result of sports-related injuries, in the United States, nowhere is sports-related pain more common than in the NFL. NFL football is a collision sport laden with serious injury and medical risks (Selden et al., 2009). Data from the NFL indicate that up to 68% of NFL players may be injured in any given year (Halchin, 2008), potentially leading to long term consequences from an increased risk for more

<sup>☆</sup> A copy of the survey instrument used in this study can be found as supplementary materials by accessing the online version of this paper at <http://dx.doi.org>.

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serious injury (Schwenk et al., 2007; Orchard and Seward, 2002) and pain.

While attention has been paid to differential mortality, the effects of increased obesity, cardiovascular problems (Selden et al., 2009) and concussions among former professional athletes (Casson et al., 2009; Guskiewicz et al., 2005), no research has been published to date concerning the impact of pain on use and misuse of opioids both during and after a player's professional athletic career. To fill this gap, 644 former professional athletes – NFL players – were interviewed to evaluate level of pain and other factors associated with opioid misuse during their NFL career and in the past 30 days. Multivariate analyses were conducted to predict current patterns of prescription opioid use and misuse.

## 2. Methods

### 2.1. Data source and sample

The sampling frame consisted of 1788 players listed in the 2009 Retired NFL Football Players Association Directory who retired between 1979 and 2006 and had at least one telephone number listed. To concentrate recruitment efforts, three samples of approximately 600 players each were randomly selected and stratified on the basis of year played and position.

### 2.2. Data collection

Potential participants were contacted during the day and evening, and on weekends, from March to August 2010. Professional interviewers utilized a standard oral script to contact potential study participants by telephone to explain the purpose of the study and obtain verbal consent. No incentives were provided for participation in the 20 min survey. Study protocols were approved by the Human Research Protection Office at the Washington University School of Medicine.

### 2.3. Survey instrument

The *Survey of Retired NFL Football Players* is a 62-item assessment, developed for a telephone interview format and vigorously pre-tested among NFL players who were not part of the sample pool. The survey covered general demographic items, health status, pain, impairment, alcohol use, and prescription opioid and illicit drug use.

Demographic variables used in at least one analysis included mean age, race, employment status, most played NFL position, and years since retirement.

Health items included perceived health status at the start of the NFL career, at retirement, and currently (excellent, good, fair or poor); number and type of NFL injuries, and diagnosed and undiagnosed concussions. To assess concussions, two questions were asked: "How many diagnosed concussions have you had as a result of an NFL injury?", followed directly by "How many undiagnosed concussions have you had?". Players often described their concussions with the words "had their bell rung", or with words such as lost consciousness for a few seconds, got confused, or friends said they were "out" or they slurred their speech. They were also asked about their use of a cane, walker or wheelchair and asked to assess mental and physical impairment from NFL injuries which was categorized as none, mild, moderate or severe.

To assess pain, each player was asked to recount the frequency and intensity of pain currently experienced from NFL injuries. An algorithm that combined the two was used to determine whether a player had no pain, mild, moderate or severe pain.

To assess current alcohol use, we defined a standard drink as: a can or bottle of beer, a glass of wine or wine cooler, a shot of hard liquor or a mixed drink with liquor. Players were asked to report the number of alcoholic drinks consumed in the past seven days.

Prescription opioid use was investigated for two time periods—during a player's NFL career and in the past 30 days. Prescription drug use in the past 30 days was assessed first using three questions from the Washington University Risk Behavior Assessment (Needle et al., 1995; Shacham and Cottler, 2010). The series began: "Now, I would like to talk about opioid medicines like [LIST OF COMMON BRAND NAMES AND GENERICS] or any other opioid medication. These are called narcotic pain medications. Let's talk about the last 30 days—that is the last month. How many days in the last 30 days did you use any of those opioid medicines that were prescribed for you and used them exactly as prescribed?". Next, the same time period was covered for opioid medications that were prescribed to them but used in a way other than prescribed, more than prescribed, after the prescription ended or for a different reason. Players who endorsed using opioids at least one day in this manner were considered past 30 day misusers. Players were then separately asked about opioid medicines that were not prescribed for them. Those who endorsed using them in this way for at least one day in the past 30 days were also considered past 30 day misusers. Players who only used opioids as prescribed in the past 30 days were categorized as "users just as prescribed." The reliability of these questions as

measured by Intraclass Correlation Coefficients (ICCs) for number of days both used and misused among community-based prescription drug misusers from the NIDA-funded Prescription Drug Use, Misuse, and Abuse study was excellent, with ICCs in the range of 0.71–0.84.

To assess opioid use during the NFL career, players were asked whether they ever used an opioid medication prior to the past 30 days. If the answer was "yes", they were asked if they used opioid medications while playing for the NFL, the number of NFL seasons the player used opioid medications; the number of opioid pills, patches or doses usually used on a typical day during the player's NFL career; the largest number of opioid pills, patches or doses used per day during the player's NFL career; the source of the medications and the reasons for use. Players who reported that they used more pills or used pills for more days than prescribed; misled a physician to get opioids; used someone else's prescription, or received opioids from a teammate, coach, trainer, the "pill guy", a family member or friend, a dealer or the Internet, during their NFL careers, were categorized as NFL misusers. Players were also asked if anyone had ever said they had a problem with opioid medications and asked about the percentage of their teammates who misused prescription opioids during their careers in the NFL.

### 2.4. Statistical analysis

Unconditional odds ratios (OR) and their 95% confidence intervals (95%CI) were computed among subsets of the entire sample, comparing players who either used or did not use during the NFL, with non-users as the referent category. This was followed by comparisons between those who used just as prescribed and those who misused during their NFL career. Odds ratios and 95% confidence intervals were also computed comparing past 30 day opioid users who used just as prescribed and those who misused to non-users. Finally, multivariate logistic regression with backward elimination was used to identify persistent risk factors of past 30 day opioid misuse; adjusted odds ratios (AOR) are reported. All analyses were conducted with SAS® version 9.2 software (SAS Institute, Inc., Cary, NC).

## 3. Results

Of the 1788 retired NFL players in the sampling pool, 599 (33.5%) had incorrect or disconnected telephone numbers; five (0.3%) died prior to study commencement. The eligible sample, therefore, contained 1184 individuals. Of these, 83 (7%) refused and 457 (38.6%) were unreachable. A total of 644 players (54.4%) completed the survey and are the focus of these analyses. Although more players might have been reachable with additional time, we exhausted the limited funds available for the effort. The largest proportion of players was from the southeast (37%) with 21% from the west coast, 19% from the midwest, 14% from the southwest, and 9% from the northeast.

### 3.1. Sample characteristics

As shown in Table 1, the players were 48.3 years of age (SD 9.24) on average; 52% were Caucasian and 45% African American. Offensive lineman was the position most frequently played (28%). On average, players were retired 17.7 years (SD 8.47) and reported playing 7.6 years (SD 3.8). Most (88%) felt they were in excellent health at the start of their careers, but only 13% felt the same in the past 30 days.

Knee injuries were the most commonly reported NFL injuries, followed by shoulder and back. Nearly half (47%) had 3 or more NFL injuries. Concussions from NFL play were prevalent: nearly half (49%) reported diagnosed concussions; 81% reported undiagnosed concussions. The average number of reported concussions of either type was 9 (SD 20.4). Over half (55%) reported a career-ending injury with 6% reporting current use of a cane, walker, or wheelchair. Additionally, players perceived that nearly one-third (29.4%) of their teammates misused prescription opioids. Of the 644 players in the sample, 14 (2.2%) reported that someone told them that they had a problem with opioid medications.

### 3.2. Trajectory of use and misuse from NFL to present

Shown in Fig. 1 is the trajectory of use from the NFL through the interview period; 52% ( $n = 336$ ) of retired NFL play-



**Table 1**

Characteristics of retired NFL players by opioid use status while playing for the NFL.

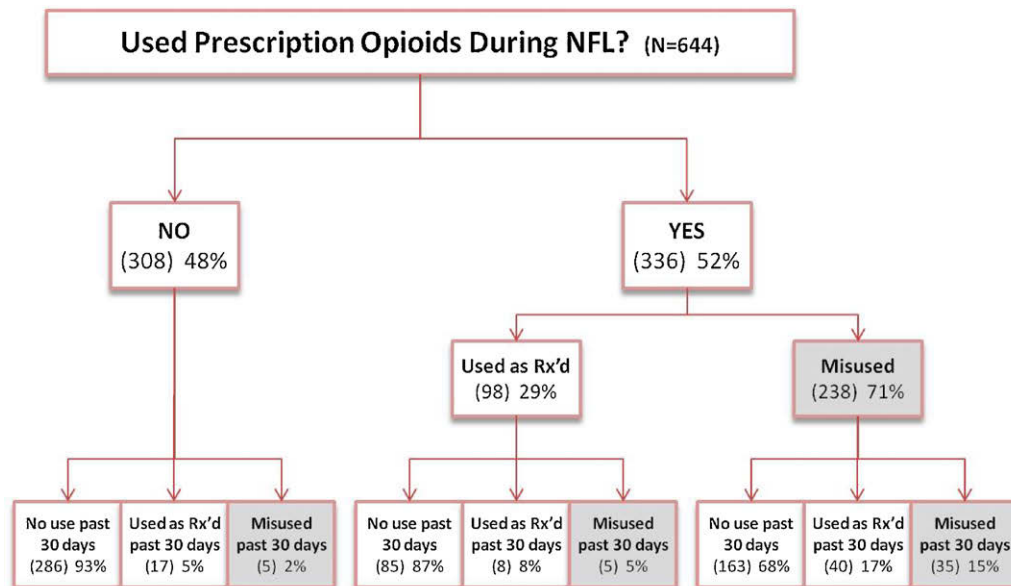
	Total sample (N = 644) %	A Non users (N = 308)	B Users (N = 336)	Odds ratio (95%CI) B vs. A
Age				
Mean age in years (SD)	48.3(9.24)	49.7(9.33)	47.1(8.99)	.97 (.95–.99)
Race/ethnicity				
White/Caucasian	(332)52%	46%	57%	1.56 (1.14–2.13)
Black/African American	(292)45%	51%	40%	.63 (.46–.86)
Others	(20)3%	3%	3%	ns
Primary NFL position				
Offensive lineman	(183)28%	21%	35%	2.09 (1.47–2.98)
Offensive ball handler	(144)22%	26%	19%	.67 (.46–.97)
Defensive lineman	(128)20%	20%	20%	ns
Defensive secondary	(107)17%	18%	16%	ns
Cornerback or Safety	(49)8%	10%	6%	ns
Other position	(33)5%	6%	4%	ns
NFL involvement				
Average # years played (SD)	7.6(3.80)	7.5(4.02)	7.6(3.58)	ns
Mean years since retirement (SD)	17.7(8.47)	19.0(8.17)	16.5(8.58)	.97 (.95–.98)
Excellent health				
At start of career	(569)88%	88%	89%	ns
At retirement	(113)18%	21%	15%	.65 (.43–.98)
In past 30 days	(84)13%	17%	9%	.49 (.31–.79)
NFL injuries				
Knee	(391)61%	54%	67%	1.69 (1.23–2.32)
Shoulder	(265)41%	34%	48%	1.76 (1.28–2.42)
Back	(264)41%	36%	46%	1.48 (1.08–2.04)
Had 3 or more NFL injuries	(304)47%	38%	56%	2.05 (1.50–2.81)
Concussions				
Diagnosed	(309)49%	48%	49%	ns
Undiagnosed	(486)81%	75%	86%	2.05(1.35–3.11)
NFL injury consequences				
Had career-ending injury	(356)55%	49%	61%	1.68 (1.23–2.30)
Had injury requiring use of cane, walker or wheelchair	(39)6%	5%	7%	ns
Substance use				
Perceived % of teammates who misused Rx opioids (SD) (n = 407)	27.3% (24.65)	23.4% (22.80)	30.25% (25.63)	1.01 (1.00–1.02)

Abbreviations: CI, confidence interval; NFL, National Football League; Rx, prescription; SD, standard deviation; ns, not significant; #, number; %, percentage. Offensive ball handler is defined as Quarterback, Wide Receiver, Running Back or Full Back.

ers reported using opioids during their NFL careers. Of those players, 37% obtained their opioids exclusively from a doctor, 12% got them exclusively from a non-medical source, and the remaining majority (51%), reported the source of their prescription opioids to be a combination of both doctors and illicit

sources such as a teammate, coach, athletic trainer, or family member.

Of the players who used prescription opioids in the NFL ( $n = 336$ ), 71% misused in the NFL. Among NFL misusers, 17% ( $n = 40$ ) used just as prescribed in the past 30 days, 68% ( $n = 163$ ) reported no use, and

**Fig. 1.** History of prescription opioid use from NFL to present.

15% ( $n=35$ ) reported misuse. Among those who used just as prescribed in the NFL, 8% ( $n=8$ ) also used just as prescribed in the past 30 days, 87% ( $n=85$ ) reported no use, and 5% ( $n=5$ ) reported misuse. Thus, players who misused during their NFL career were 3.2 times as likely to misuse in the past 30 days as NFL players who used just as prescribed (95%CI 1.22–8.44). Among those players who reported no opioid use during their NFL careers ( $n=308$ ), 93% reported no opioid use in the past 30 days, while 2% and 5% reported misuse and use just as prescribed, respectively. Of the 7% ( $n=45$ ) of players who reported past 30 day opioid misuse (shaded boxes), 78% (35/45) had a history of opioid misuse during their NFL career.

### 3.3. Use vs. non-use, during the NFL

Comparisons of opioid use patterns were made between players who used during their NFL career ( $n=336$ ) and those who did not ( $n=308$ ). As shown in Table 1, younger and Caucasian players had an increased risk for any opioid use during their NFL careers compared to older and non-Caucasian players. Offensive linemen were 2.09 times as likely as all others to use opioids (95%CI 1.47–2.98). Users were more likely to report knee injuries, compared to non-users (67% vs. 54% with OR 1.69, 95%CI 1.23–2.32). Persons with at least 3 NFL injuries and injuries that ended their careers had increased odds for reporting opioid use during their NFL careers compared to persons with a lower injury threshold (OR 2.05, 95%CI 1.50–2.81) or without a career ending injury (OR 1.68, 95%CI 1.23–2.30). While diagnosed concussions did not predict opioid use during players' NFL careers, undiagnosed concussions did increase the odds for reporting opioid use (OR 2.05, 95%CI 1.35–3.11). Players who used opioids during their NFL careers had been retired fewer years and reported worse current health than those who did not use opioids during their NFL careers. A weak association was found between opioid use during a player's NFL career and the perception that one's teammates misused prescription opioids.

### 3.4. Misuse vs. use just as prescribed, during the NFL

Though not shown, we compared players who used opioids just as prescribed during their NFL careers ( $n=98$ ; 29%) to those who misused them ( $n=238$ ; 71%). Only two differences were found: misusers had increased odds for poor health at retirement (OR .35, 95%CI .16–.73) and had 3 or more NFL injuries (OR 1.85, 95%CI 1.15–2.97).

Additional analyses were performed to further elucidate the association between NFL misuse and other factors. On average, players who misused opioids used them for 5.9 seasons (SD 3.73) compared to 3.7 seasons (SD 2.99) among those who used just as prescribed ( $p<.0001$ ). While there were no statistically significant differences noted in the number of opioid pills, patches or liquid doses used on a typical day between those who misused and those who used just as prescribed during their careers in the NFL, 22% of misusers reported taking 6 or more pills per day vs. 10% of players who used just as prescribed ( $p=.01$ ).

### 3.5. Misuse vs. non-use, in the past 30 days

Comparisons of players by current past 30 day opioid use status (Table 2) were done for misusers vs. non-users (45 vs. 534), misusers vs. those who used just as prescribed (45 vs. 65), and for users and misusers vs. non-users (110 vs. 534).

Misusers were less likely than non-users (C vs. A) to report excellent health in the past 30 days (2% vs. 15%), more likely to report knee, shoulder and back injuries, and over 6 times as likely to report 3 or more NFL injuries (OR 6.02, 95%CI 2.75–13.18). Nearly all (98%) misusers, compared to non-users (79%), reported undiagnosed con-

cussions (OR 11.22, 95%CI 1.53–82.48), the strongest predictor of misuse in the bivariate analysis. Misusers were at increased odds of having a career ending injury and nearly 8 times as likely to be using a cane, walker or wheelchair (OR 7.59, 95%CI 3.16–18.22) compared to their non-using teammates. Nearly 80% of the misusers met criteria for severe pain compared to 39% of non-users (OR 4.50, 95%CI 2.42–8.40). When compared to non-users, misusers reported more self-perceived moderate to severe physical (OR 3.49, 95%CI 1.76–6.91) and mental (OR 2.62, 95%CI 1.38–4.97) impairment.

Players who drank more than 14 drinks in a 7 day period, considered heavy use by the National Institute on Alcohol Abuse and Alcoholism (NIAAA, 2010), had increased odds of opioid misuse (OR 3.92, 95%CI 1.96–7.81). This association persisted for those drinking 20+ drinks (equal to a fifth of liquor) in the previous week (OR 4.47, 95%CI 2.14–9.33). Misusers perceived that 43% of their teammates were likely to misuse opioids compared to 25% among non-users.

Although not shown, multivariate regression analysis, predicting current misuse, with non-use as the referent group, indicated three main determinants: moderate to severe pain (AOR 8.33, 95%CI 1.98–35.04), undiagnosed concussions (AOR 3.51, 95%CI 1.98–35.04) and drinking 20+ drinks in the past week (AOR 3.48, 95%CI 1.63–7.41).

### 3.6. Misuse vs. use just as prescribed, in the past 30 days

A comparison of current misusers to users just as prescribed (C vs. B in Table 2) indicated that players who were younger, retired fewer years, with knee or shoulder injuries, three or more NFL injuries, undiagnosed concussions, and who reported drinking more than 14 drinks per week were at increased odds for past 30 day opioid misuse. However, past 30 day misusers of prescription opioids were no more likely than players who used just as prescribed to be impaired from their injuries and to report more pain.

Multivariate analyses indicated that undiagnosed concussions singly, net of all other variables, predicted opioid misuse (AOR 4.25, 95%CI 1.12–16.22).

### 3.7. Use vs. non-use, in the past 30 days

When past 30 day users, regardless of misuse patterns, were compared with non-users (BC vs. A in Table 2), many differences were noted, but those with an odds ratio greater than 2.0 included back injury, three or more NFL injuries, undiagnosed concussions, moderate to severe physical and mental impairment and drinking more than 14 drinks per week. However, two additional factors were strongly associated with opioid use: requiring a cane, walker or wheelchair (OR 7.59, 95%CI 3.88–14.86), and having severe pain (OR 4.02, 95%CI 2.62–6.16).

Multivariate analyses increased the strength of the association for moderate to severe pain in predicting opioid use (AOR 6.76, 95%CI 2.88–15.87). Two additional variables remained in the model after backward elimination: moderate to severe mental impairment (AOR 1.88, 95%CI 1.19–2.98) and drinking 20+ drinks in the past week (AOR 2.15, 95%CI 1.17–3.98).

## 4. Discussion

The Survey of Retired NFL Football Players sheds some light on the physical and mental health and opioid use patterns among a cohort of 644 players. Of particular note is their reported overall health deterioration—only 13% reported current excellent health compared to 88% with excellent health at the time they signed their first NFL contract. Pain from NFL injuries was significant. Specifically, 93% of our sample reported pain with 81% of the players

**Table 2**  
Characteristics of retired NFL players by past 30 day use of opioids (N = 644).

	A No use in past 30 days (N = 534)	B Used just as Rx'd in past 30 days (N = 65)	C Misused in past 30 days (N = 45)	Odds ratio (95%CI)		
				C vs. A	C vs. B	BC vs. A
Age						
Mean age in years (SD)	48.3 (9.3)	51 (8.7)	47 (9.1)	ns	.95 (.91–.99)	ns
Race/ethnicity						
White/Caucasian	50%	55%	62%	ns	ns	ns
Current employment						
Unemployed	9%	18%	11%	ns	ns	1.89 (1.04–3.44)
Primary NFL position						
Offensive lineman	27%	35%	36%	ns	ns	ns
Offensive ball handler	23%	20%	13%	ns	ns	ns
Defensive lineman	19%	22%	27%	ns	ns	ns
Defensive secondary	18%	8%	16%	ns	ns	ns
Cornerback or safety	8%	6%	4%	ns	ns	ns
Other position	5%	9%	4%	ns	ns	ns
NFL involvement						
Mean years since retirement (SD)	17 (8.5)	20 (8.2)	17 (8.1)	ns	.95 (.91–1.00)	ns
Excellent health						
At start of career	88%	92%	84%	ns	ns	ns
At retirement	20%	9%	2%	.09 (.01–.67)	ns	.27 (.12–.61)
In past 30 days	15%	5%	2%	.13 (.02–.95)	ns	.21 (.08–.60)
NFL injuries						
Knee	60%	54%	76%	2.04 (1.01–4.11)	2.65 (1.15–6.12)	ns
Shoulder	40%	38%	58%	2.05 (1.11–3.79)	2.19 (1.01–4.75)	ns
Back	37%	60%	64%	3.13 (1.66–5.90)	ns	2.79 (1.83–4.27)
Had 3 or more NFL injuries	43%	54%	82%	6.02 (2.75–13.18)	3.96 (1.60–9.81)	2.47 (1.61–3.79)
Concussions						
Diagnosed	47%	53%	58%	ns	ns	ns
Undiagnosed	79%	85%	98%	11.22 (1.53–82.48)	7.41 (.90–60.89)	2.49 (1.25–4.94)
NFL injury consequences						
Had career-ending injury	53%	65%	73%	2.47 (1.25–4.88)	ns	1.92 (1.24–2.97)
Had injury requiring use of cane, walker or wheelchair	3%	20%	20%	7.59 (3.16–18.22)	–	7.59 (3.88–14.86)
Pain level						
None	8%	0%	0%	–	–	–
Mild	24%	6%	4%	.33 (.13–.85)	ns	.38 (.21–.69)
Moderate	29%	22%	18%	ns	ns	ns
Severe	39%	72%	78%	4.50 (2.42–8.40)	ns	4.02 (2.62–6.16)
Impairment						
Physical (moderate to severe)	44%	66%	73%	3.49 (1.76–6.91)	ns	2.84 (1.83–4.40)
Mental (moderate to severe)	19%	37%	38%	2.62 (1.38–4.97)	ns	2.56 (1.64–3.40)
Substance use						
Mean drinks (SD) in past 7 days	6 (9.1)	7 (16.1)	11 (13.5)	1.04 (1.01–1.06)	ns	1.02 (1.01–1.04)
15+ drinks in past 7 days	10%	11%	31%	3.92 (1.96–7.81)	3.68 (1.34–10.07)	2.07 (1.19–3.59)
20+ drinks in past 7 days	8%	11%	27%	4.47 (2.14–9.33)	2.96 (1.06–8.26)	2.60 (1.44–4.69)
Perceived % of teammates who misused Rx opioids (SD) (n = 407)	25% (23.0)	35% (27.0)	43% (29.0)	1.03 (1.01–1.04)	ns	1.02 (1.01–1.03)

perceiving their pain to be moderate to severe. This level of pain is over three times the rate (26%) of the general population (Alaranta et al., 2008). That, along with the high rate of 3 or more NFL injuries, might have resulted in the high rate of prescription pain medication use during the NFL career.

In fact, over half (52%) of the players reported using prescription opioids during NFL play. The overall rate of misuse during NFL play was 37% (238/644), a rate 2.9 times higher than the lifetime rate of non-medical use of opioids among the general population of a comparable age (12.7%). Past 30 day misuse among the players was found to be 7%, compared to 1.6% of the adults 26 and older in the general population (SAMHSA, 2009) and 2.5% among men of the same age (personal communication with SAMHSA).

Few prospective studies have examined the incidence of opioid misuse among patients with chronic pain. Ives et al. (2006) found that 32% of chronic pain patients misused opioids during one year of monitoring. While not necessarily comparable, our study found that 71% of opioid users misused during their NFL career. The strongest predictors of opioid use during their playing career were undiagnosed concussions, having three or more injuries, and being

an offensive lineman. Offensive linemen have also been shown to be the least healthy football players, since they are the heaviest, and have been found to have cardiovascular problems (Selden et al., 2009).

Players who misused opioids in the NFL were similar to players who used them just as prescribed except for worsened perceived health and history of three or more NFL injuries. This difference could be attributed to the fact that two variables that predict current misuse (number of alcoholic drinks and level of pain) were not obtained for the period of NFL play due to the constraint in the telephone survey time limits. This is one major area for further research. Undiagnosed concussions, which were reported by 81% of the sample, were strongly associated with misuse of opioids. This association might have been due to the fact that those who choose not to report concussions are the same players who choose not to reveal their pain to a physician, thus, managing their pain on their own. They may believe that if they report a concussion, they will be pulled from active play.

Our results are informative regarding the original purpose of this study—to understand current pain and management of pain.

Comparing misusers to non-users, unconditional odds ratios over 6 were: three plus injuries; using a cane, walker or wheelchair and undiagnosed concussions. In the multivariate analysis, moderate to severe pain, undiagnosed concussions, and drinking 20+ drinks in a week were the strongest predictors of current misuse. Undiagnosed concussions remained the only variable in the multivariate analysis that discriminated between current misusers and users just as prescribed. When all current users were compared to non-users, the strongest predictors of current use net of all others were: moderate to severe pain, drinking 20+ drinks in a week, and moderate to severe mental impairment. Players who misused during their career in the NFL were found to be more than three times as likely to be current misusers than those who used just as prescribed during their NFL career.

Our study has several limitations that should be noted. First, players were members of the Retired Players Association, which may represent healthier men. This could have led to an underestimated rate of use and misuse of opioids among retired players. Qualitative interviews of players not in the Association conducted by co-authors (JB and RB) found multiple examples of serious and heavy opioid use which validate this conjecture. Another limitation, mentioned previously, was the lack of more detailed information about pain and alcohol use during a player's career. More research on comorbid conditions associated with pain and misuse is warranted. Our definition of misuse might also be considered a limitation by some, although we consider it among the most comprehensive because it includes misuse of one's own prescription. The NSDUH definition of misuse is defined as use without a prescription or use simply for the experience or feeling the drug causes. Because it does not take into account individuals who misused their own prescription, the NSDUH rates for misuse are underestimated. Additionally, we note that the NSDUH definition of misuse includes other drugs such as tranquilizers, stimulants, and sedatives that are taken for pain, whereas ours includes only opioids. Finally, while the sample size was large enough to detect an increase in odds ratios of 2 or larger with 80% power for data during the NFL, it was less adequate for analyses regarding misuse in the past 30 days. Confidence intervals were provided to give the reader an estimate of the variation of the sample parameters for all results.

There were several strengths to this study, including being the first to survey players about management of pain, focused on prescription pain medicines both during their NFL careers and in the past 30 days. Because this study utilized a phone survey, and did not rely on mailed questionnaires, the study interviewers were able to validate the identity of a person through additional information obtained during introductory conversation. This survey goes beyond case reports and does not suffer the bias of just one team, injury or geographical region. Additionally, the use of an interview found to be reliable for eliciting data on prescription drug use among a general population sample is a major strength (Shacham and Cottler, 2010).

In summary, to our knowledge there have been no other studies that have simultaneously assessed pain, and opioid use and misuse among NFL players. These findings should be of interest to all athletes—both elite, collegiate, and others—due to the potential consequences of their injuries while playing and after retirement. Professional athletes who utilize opioids to facilitate the management of pain due to sports-related injuries need to guard against misuse during their careers as well as during the period following their retirement. Anecdotal data suggest that many injured players are able to play football only because of their use of prescription pain medications. Additionally, since these players often do not have sufficient time off during the NFL season to heal their injuries, they reinjure themselves. A cycle of injury, pain, and reinjury could lead to subsequent pain pill use during the NFL which

in turn could result in later life disability, continued pain and misuse of prescription pain pills.

At the conclusion of the interview, players were allowed time to share additional thoughts. Many of them provided compelling anecdotes about the terrible pain they live with. They also confirmed that players should be continuously monitored during their careers for misuse of prescription opioids. While some noted that playing in the NFL was not worth the accelerated loss of health, others said they still would have played despite knowing the risks.

The dangers of prescription drugs to athletes have been discussed previously (Alaranta et al., 2008) though opioid use was not described. Opioids represent one additional potential danger to athletes. The opioid use patterns and player characteristics found in this study suggest a need for longitudinal studies to assess the trajectory of sports-related pain among all elite athletes.

### Role of funding source

This study (Survey of Retired NFL Football Players; LB Cottler, PI) was funded by ESPN (Entertainment and Sports Programming Network). Additional funding was provided by the National Institute on Drug Abuse of the National Institutes of Health (NIDA; Research Supplement for Retired Professional NFL Football Players; Prescription Drug Misuse, Abuse and Dependence, DA020791-04S2; LB Cottler, PI). ESPN staff Barr, Banks and Forchheimer contributed to the study concept and participated in revisions of the manuscript. They had no role in the collection, analysis or interpretation of data. NIDA had no role in the study design, in the collection, analysis or interpretation of data, in the writing of the report, or in the decision to submit the paper for publication.

### Contributors

All authors contributed to the study concept and authors Cottler, Cummings and Ben Abdallah were responsible for the study design. Authors Cottler and Cummings supervised the conduct of the study. Author Ben Abdallah performed the data analysis, and authors Cottler, Cummings and Ben Abdallah were responsible for interpretation of data. Authors Cottler, Ben Abdallah and Cummings drafted the manuscript. All authors contributed to and have approved the final manuscript.

### Conflict of interest

Authors Cottler and Ben Abdallah currently receive funding from Pinney Associates to conduct a national epidemiological study of stimulant use among teenagers. Pinney Associates is funded from Shire Pharmaceuticals for that study. Neither Cottler nor Ben Abdallah is a clinician. All other authors declare that they have no conflicts of interest.

### Acknowledgements

The authors would like to thank all of the retired players who participated in this study for their willingness to complete the survey, as well as the staff members who conducted the interviews.

### Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at [doi:10.1016/j.drugalcdep.2010.12.003](https://doi.org/10.1016/j.drugalcdep.2010.12.003).

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